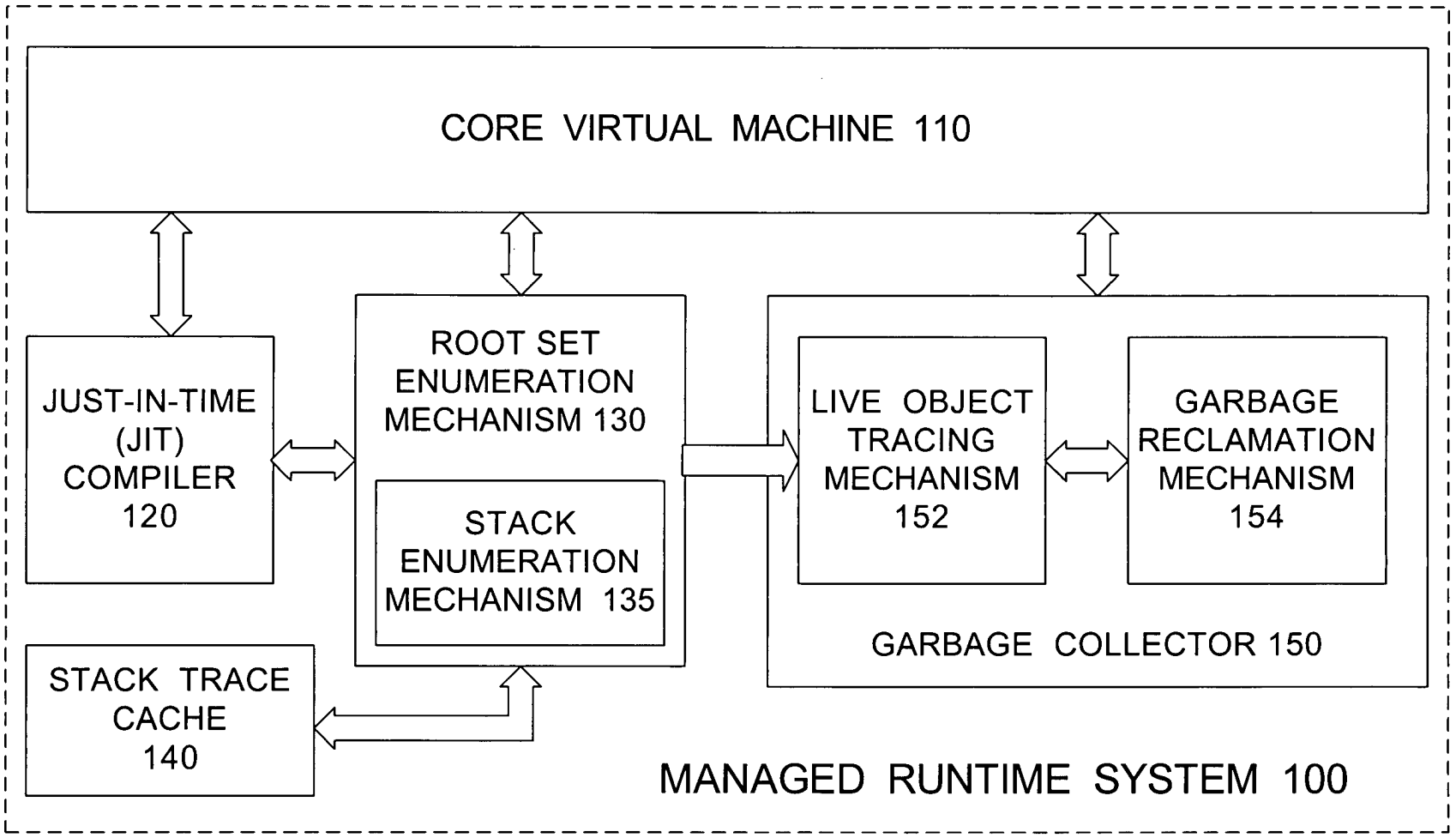
CORE VIRTUAL MACHINE 110
JUST-IN-TIME (JIT) COMPILER 120
ROOT SET ENUMERATION MECHANISM 130
STACK ENUMERATION MECHANISM 135
LIVE OBJECT TRACING MECHANISM 152
GARBAGE RECLAMATION MECHANISM 154
GARBAGE COLLECTOR 150
STACK TRACE CACHE 140
MANAGED RUNTIME SYSTEM 100

FIGURE 1

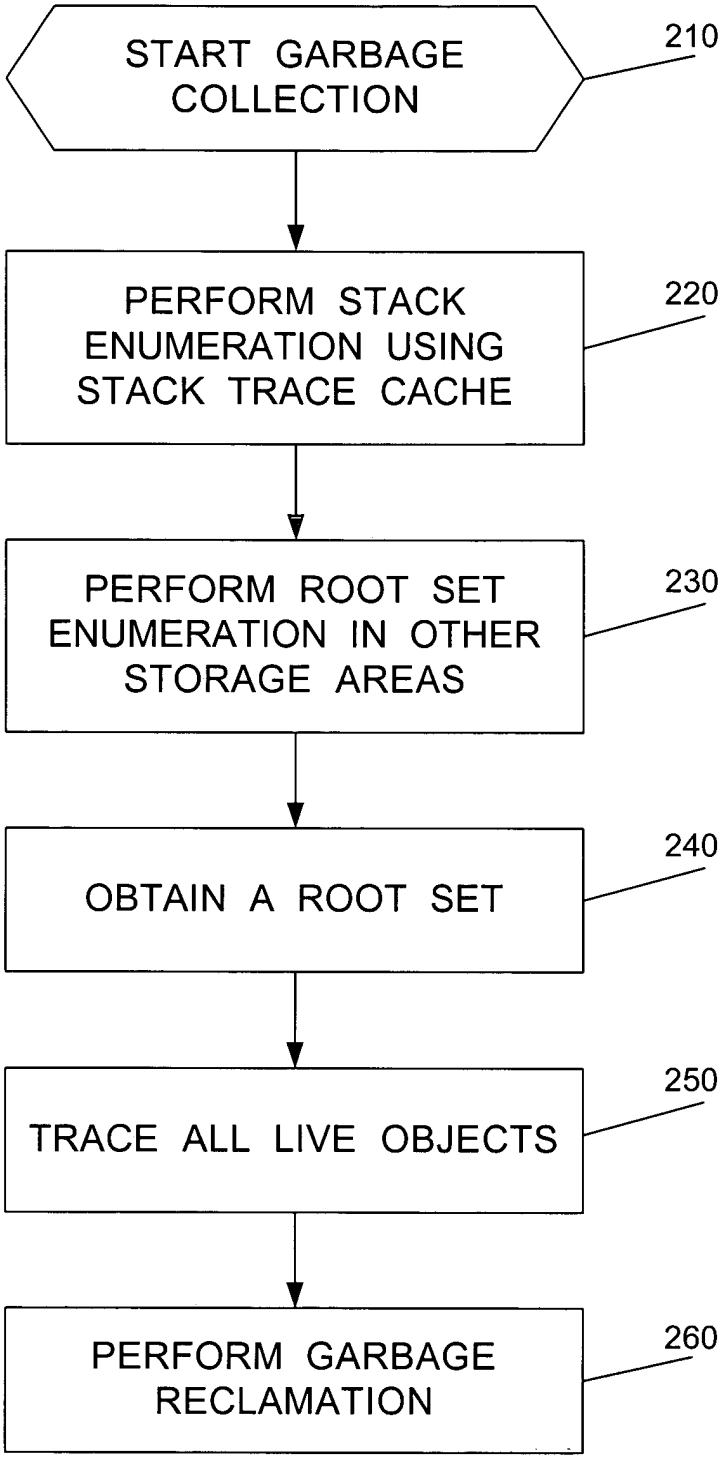
START GARBAGE COLLECTION
210
PERFORM STACK ENUMERATION USING STACK TRACE CACHE
220
PERFORM ROOT SET ENUMERATION IN OTHER STORAGE AREAS
230
OBTAIN A ROOT SET
240
TRACE ALL LIVE OBJECTS
250
PERFORM GARBAGE RECLAMATION
260

FIGURE 2

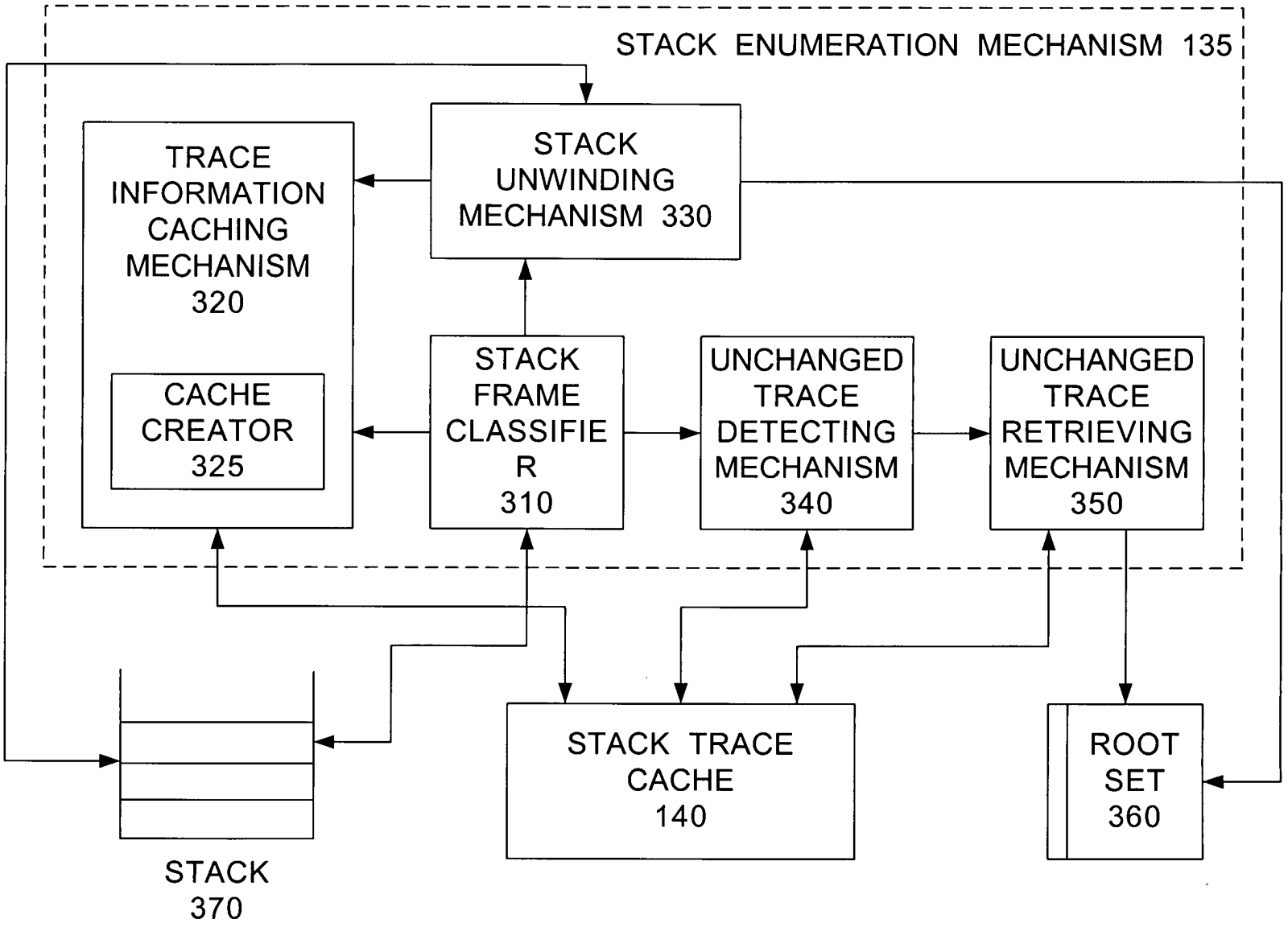
STACK ENUMERATION MECHANISM 135
TRACE INFORMATION CACHING MECHANISM 320
CACHE CREATOR 325
STACK UNWINDING MECHANISM 330
STACK FRAME CLASSIFIER 310
UNCHANGED TRACE DETECTING MECHANISM 340
UNCHANGED TRACE RETRIEVING MECHANISM 350
STACK TRACE CACHE 140
ROOT SET 360
STACK 370

FIGURE 3

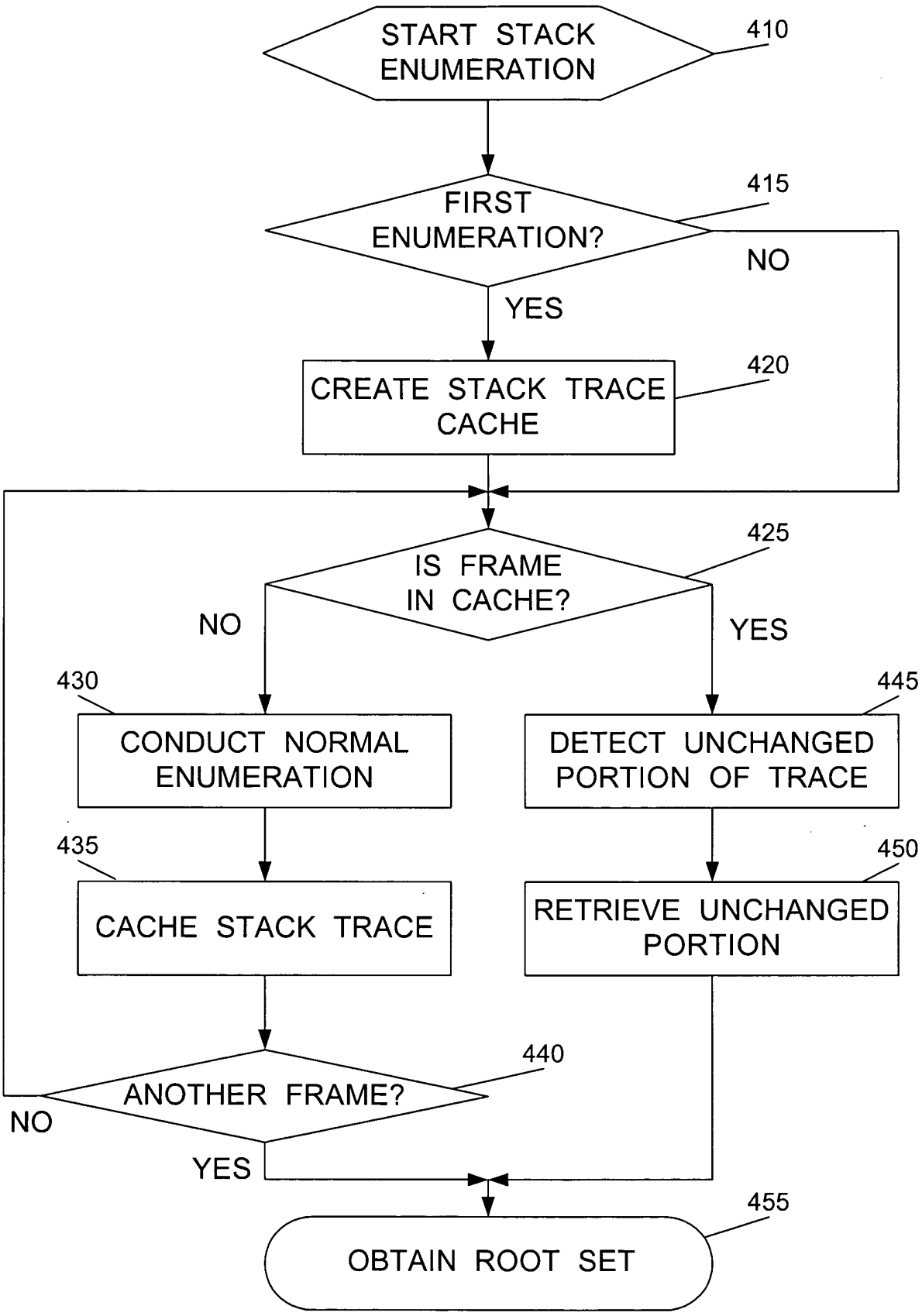
START STACK ENUMERATION
410
FIRST ENUMERATION?
415
NO
YES
CREATE STACK TRACE CACHE
420
IS FRAME IN CACHE?
425
NO
YES
430
CONDUCT NORMAL ENUMERATION
445
DETECT UNCHANGED PORTION OF TRACE
435
CACHE STACK TRACE
450
RETRIEVE UNCHANGED PORTION
ANOTHER FRAME?
440
NO
YES
OBTAIN ROOT SET
455

FIGURE 4

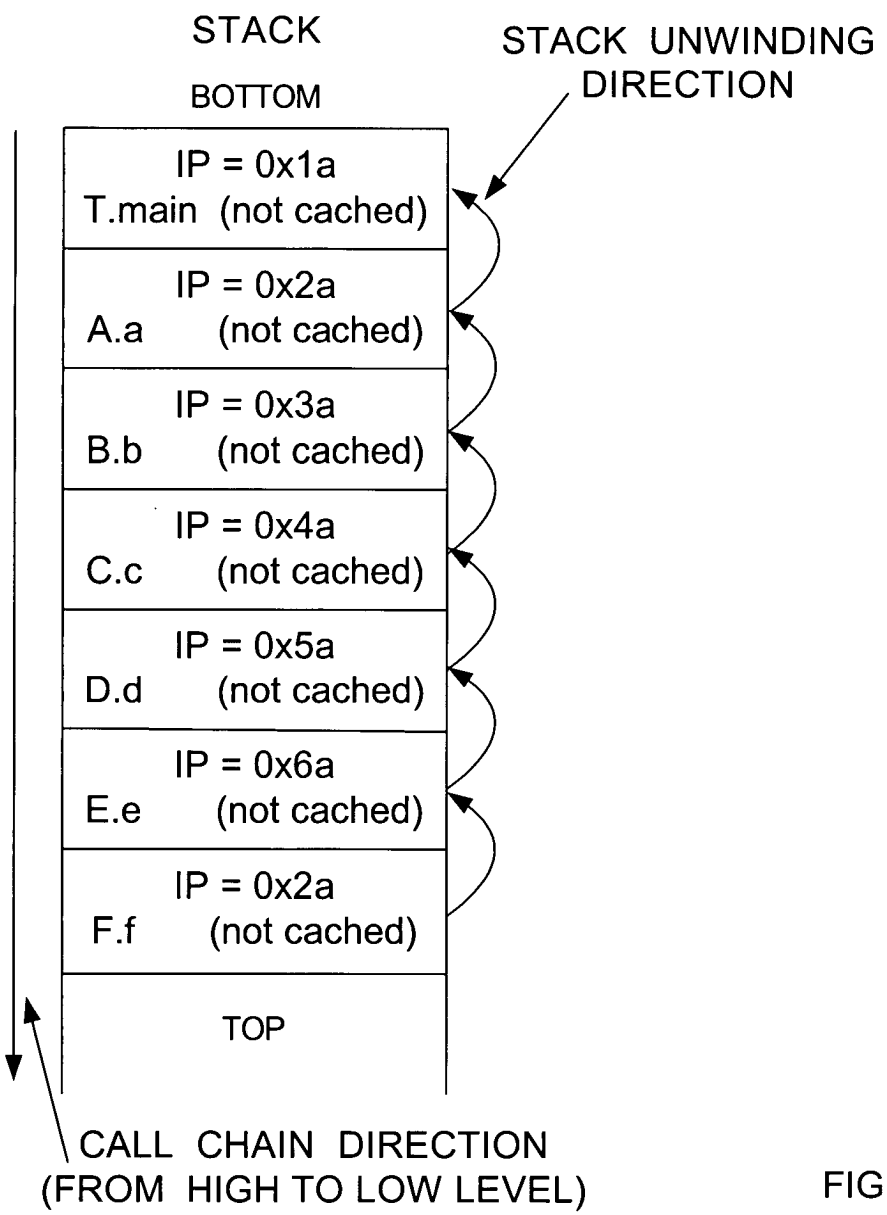
STACK
BOTTOM
STACK UNWINDING DIRECTION
IP = 0x1a
T.main (not cached)
IP = 0x2a
A.a (not cached)
IP = 0x3a
B.b (not cached)
IP = 0x4a
C.c (not cached)
IP = 0x5a
D.d (not cached)
IP = 0x6a
E.e (not cached)
IP = 0x2a
F.f (not cached)
TOP
CALL CHAIN DIRECTION
(FROM HIGH TO LOW LEVEL)

FIGURE 5(a)

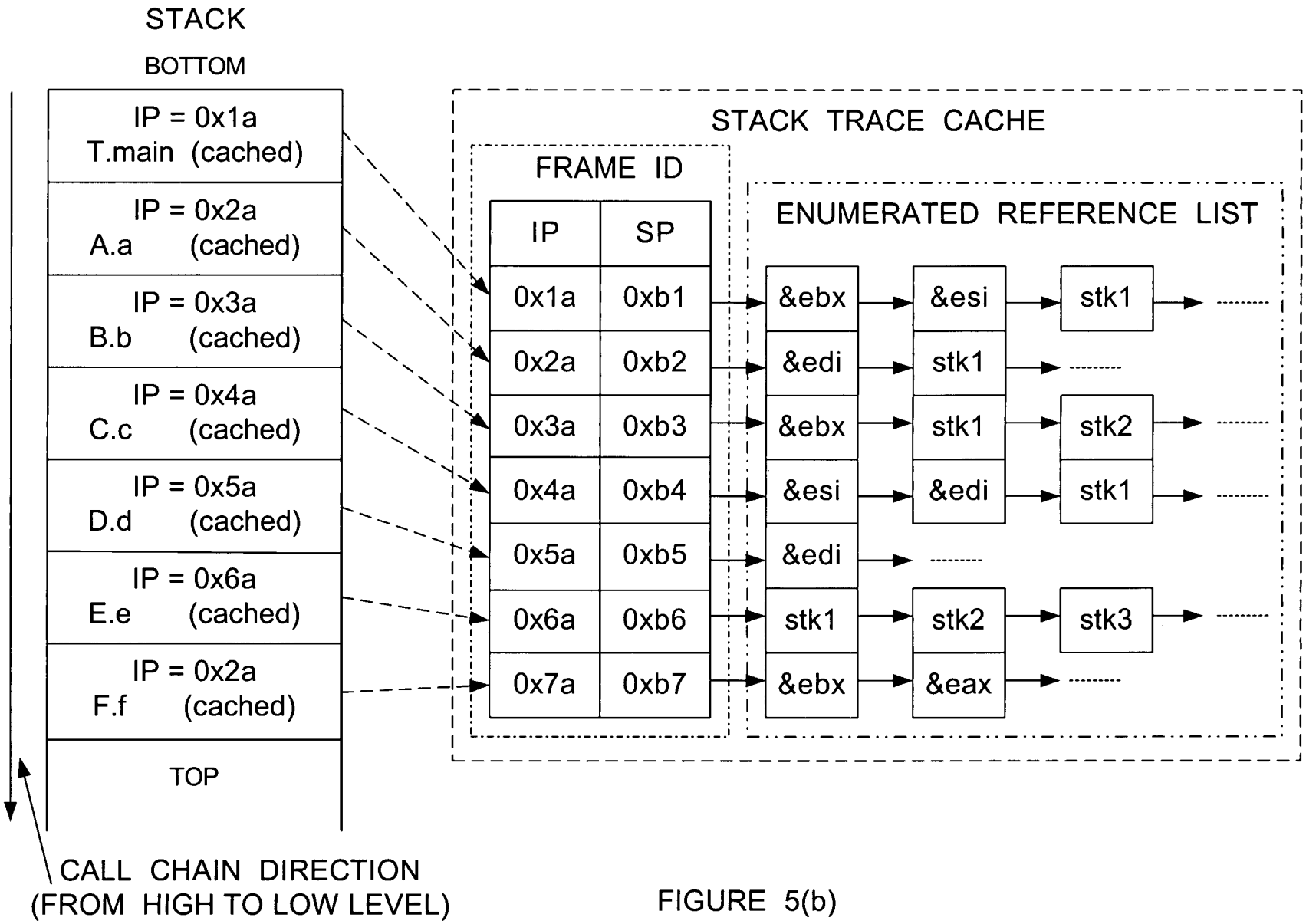
STACK
BOTTOM
IP = 0x1a
T.main (cached)
IP = 0x2a
A.a (cached)
IP = 0x3a
B.b (cached)
IP = 0x4a
C.c (cached)
IP = 0x5a
D.d (cached)
IP = 0x6a
E.e (cached)
IP = 0x2a
F.f (cached)
TOP
CALL CHAIN DIRECTION
(FROM HIGH TO LOW LEVEL)
STACK TRACE CACHE
FRAME ID
IP
SP
0x1a
0xb1
0x2a
0xb2
0x3a
0xb3
0x4a
0xb4
0x5a
0xb5
0x6a
0xb6
0x7a
0xb7
ENUMERATED REFERENCE LIST
&ebx
&esi
stk1
&edi
stk1
&ebx
stk1
stk2
&esi
&edi
stk1
&edi
stk1
stk2
stk3
&ebx
&eax

FIGURE 5(b)

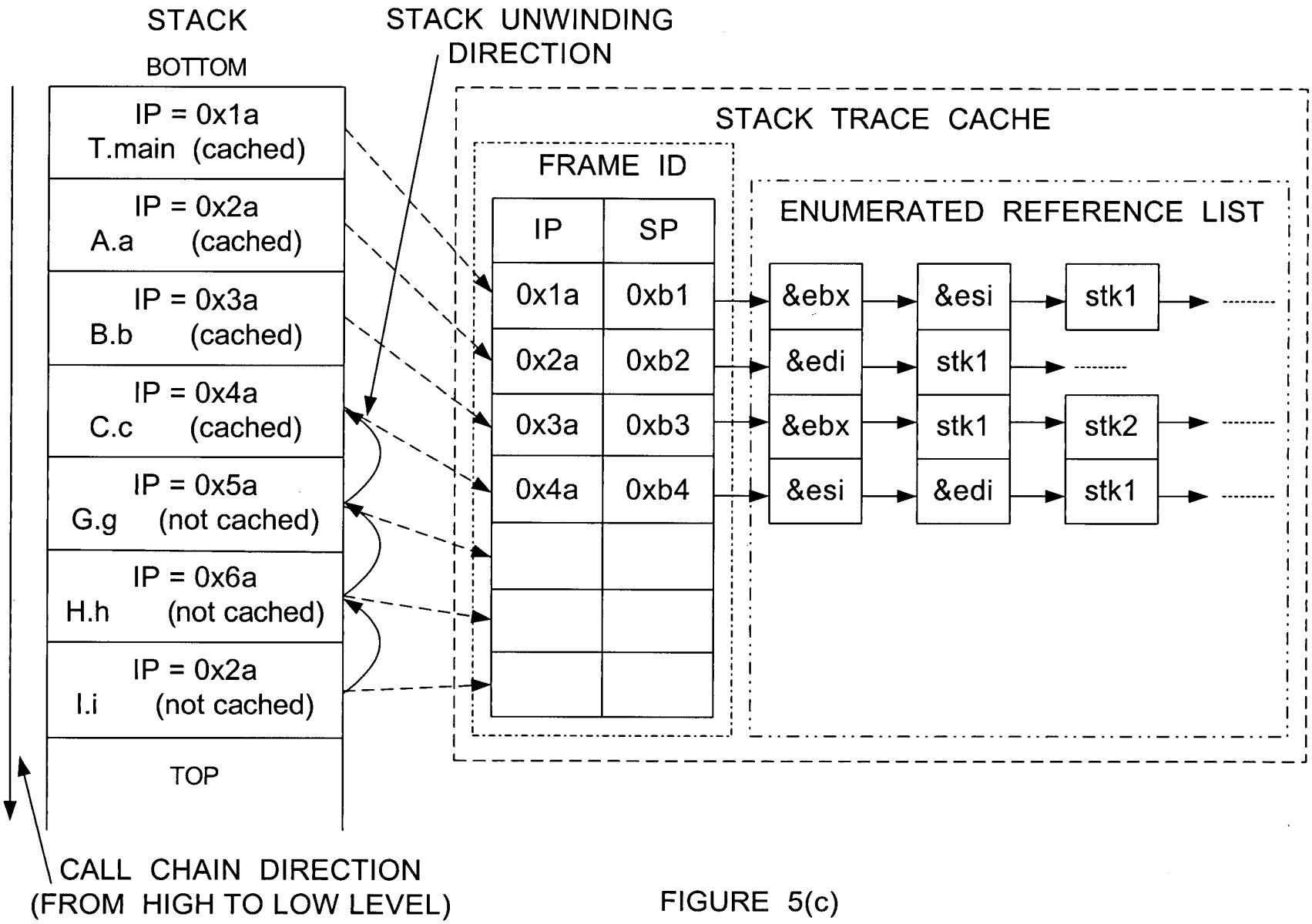
STACK
BOTTOM
IP = 0x1a
T.main (cached)
IP = 0x2a
A.a (cached)
IP = 0x3a
B.b (cached)
IP = 0x4a
C.c (cached)
IP = 0x5a
G.g (not cached)
IP = 0x6a
H.h (not cached)
IP = 0x2a
I.i (not cached)
TOP
STACK UNWINDING DIRECTION
STACK TRACE CACHE
FRAME ID
IP
SP
0x1a
0xb1
0x2a
0xb2
0x3a
0xb3
0x4a
0xb4
ENUMERATED REFERENCE LIST
&ebx
&esi
stk1
&edi
stk1
&ebx
stk1
stk2
&esi
&edi
stk1
CALL CHAIN DIRECTION
(FROM HIGH TO LOW LEVEL)

FIGURE 5(c)

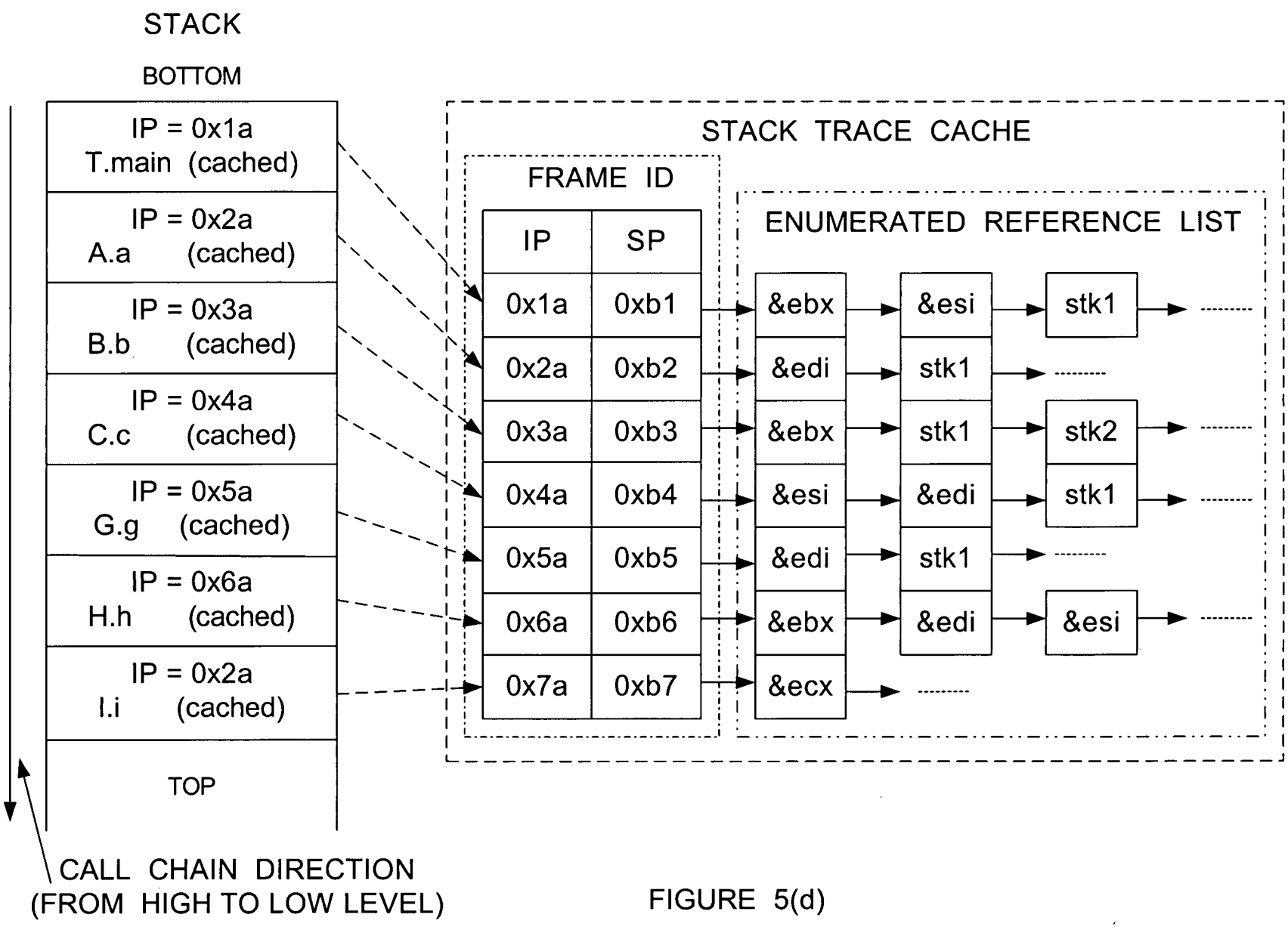
STACK
BOTTOM
IP = 0x1a
T.main (cached)
IP = 0x2a
A.a (cached)
IP = 0x3a
B.b (cached)
IP = 0x4a
C.c (cached)
IP = 0x5a
G.g (cached)
IP = 0x6a
H.h (cached)
IP = 0x2a
I.i (cached)
TOP
CALL CHAIN DIRECTION
(FROM HIGH TO LOW LEVEL)
STACK TRACE CACHE
FRAME ID
IP
SP
0x1a
0xb1
0x2a
0xb2
0x3a
0xb3
0x4a
0xb4
0x5a
0xb5
0x6a
0xb6
0x7a
0xb7
ENUMERATED REFERENCE LIST
&ebx
&esi
stk1
&edi
stk1
&ebx
stk1
stk2
&esi
&edi
stk1
&edi
stk1
&ebx
&edi
&esi
&ecx

FIGURE 5(d)